

housed at CAL. We received an image of Smith 3527 from K. Other cited specimens could not be located at K, E or P.

Because all the materials cited in the protologue are considered as syntypes *vide* Art. 9.2 (McNeill et al. 2006) and also qualify as original materials *vide* Art. 9.2 note 2 (McNeill et al. 2006). We have examined all the specimens of Smith 3527, 3662, 3907 at CAL and the image of Smith 3527 from K in detail and found that all are perfectly matching with the description given in the protologue. Moreover, all the specimens were studied by him and might have been distributed to different herbaria from India (Stafleu and Cowan 1985) as all the specimens at CAL and K bear the similar inscription of his own handwriting.

It is evident that all the materials housed at CAL and a specimen at K are alike in annotations and thus we select a well-preserved specimen housed at CAL (Smith 3527) as the lectotype.

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References

- Smith W. W. 1911. A new gentian and two new swertias from East Himalaya. *J. Asiat. Soc. Bengal*, n. s., 7(3): 69–75.
- McNeill J., Barrie F. R., Burdet H. M., Demoulin V., Hawksworth D. L., Marhold K., Nicolson D. H., Prado J., Silva P. C., Skog J. E., Wiersema J. H. and Turland N. J. 2006. International Code of Botanical Nomenclature (Vienna Code). Koeltz Scientific Books, Koenigstein.
- Stafleu F. A. and Cowan R. S. (eds.) 1985. *Taxonomic Literature*, 2nd edition, Vol. 5 (Regnum Veg. 112). Bohn, Scheltema & Holkema, Utrecht.

シッキムヒマラヤ産のリンドウ科植物 *Gentiana pluviarum* W. W. Sm. のレクトタイプ選定を行い、その手順の当否を論議し、レクトタイプの画像を提示した。

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Okihito YANO^a, Hiroshi IKEDA^{a,*}, Colin A. PENDRY^b and Keshab R. RAJBHANDARI^c: **Cytological Studies on *Cyperaceae* in the Nepal Himalaya II. Chromosome Counts of Four Species Collected from Far West Nepal**

ネパールヒマラヤ産カヤツリグサ科植物の細胞学的研究 II. 極西ネパールより採集した4種の染色体数 (矢野興一^a, 池田 博^{a,*}, C. A. ペンドリー^b, K. R. ラジバンダリ^c)

Summary: Chromosome numbers of four species of *Cyperaceae* collected from Far West Nepal are presented. The chromosome number for *Carex*

*gracilent*a Boott ex Boeck. (2n = 52) is reported for the first time. Our finding of 2n = 46 for *C. longipes* D. Don differs from previous reports. It seems that

Table 1. Species, localities, voucher specimens and chromosome numbers of four species of *Cyperaceae* collected from Far West Nepal

Species	Locality	Voucher specimen	2n
<i>Carex fusiformis</i> Nees	Doti District, Bichpani – Ghoda daune, alt. 3072 m	Ikeda & al. 20911039	44
<i>C. gracilentia</i> Boott ex Boeck.	Bajhang District, Dhahidunga Kharka, alt. 3281 m	Ikeda & al. 20911125	52
<i>C. longipes</i> D. Don	Bajhang District, Thalara – Budkhori, alt. 2496 m	Ikeda & al. 20911102	46
<i>Eleocharis palustris</i> (L.) Roem. & Schult.	Bajhang District, Ghodadaune – Lokhda, alt. 2950 m	Ikeda & al. 20911057	16

C. longipes may consist of a series of aneuploids. Chromosome numbers of *C. fusiformis* Nees ($2n = 44$) and *Eleocharis palustris* (L.) Roem. & Schult. ($2n = 16 = 4L + 12S$) agree with the previous reports.

Cytological studies have proved useful for understanding the diversification of several plant taxa in the Nepal Himalaya (Wakabayashi and Ohba 1988, Akiyama et al. 1992, Ikeda and Ohba 1999). The *Cyperaceae* is one of the larger families of flowering plants, and Koyama (1978) enumerated about 180 taxa in 19 genera of *Cyperaceae* from Nepal. Chromosome numbers of *Cyperaceae* in the Nepal Himalaya have been reported previously three times; Dietrich (1972) reported the chromosome number for *Carex atrofusca* Schkuhr subsp. *minor* (Boott) T. Koyama from eastern Nepal, Hoshino et al. (2000) reported for 11 species in four genera from Langtang Himal, central Nepal, and our preceding paper dealt with 14 species in eight genera from Manaslu Himal, central Nepal (Yano et al. 2010). However, there have been no previous cytological studies on *Cyperaceae* from western Nepal, and more cytological studies from western Nepal are necessary to fully understand the evolution and diversification of *Cyperaceae* in the Nepal Himalaya.

In 2009, a Japanese-UK-Nepalese botanical collecting team visited Doti and Bajhang districts, Far West Nepal (see Ikeda et al. 2010), and collected materials of *Cyperaceae* for cytological examinations. This is the second report of a series of papers on cytological characteristics of

Cyperaceae in the Nepal Himalaya, and focuses on the chromosome numbers of *Cyperaceae* collected from the Far West Nepal.

Karyomorphological observations were conducted on three species of *Carex* and one species of *Eleocharis* (Table 1). The methods for chromosome observation followed Yano et al. (2010). Voucher specimens are kept in the Herbarium of the University of Tokyo (TI), with duplicates available in the National Herbarium of Nepal (KATH) and the Herbarium of the Royal Botanic Garden Edinburgh (E).

Chromosome numbers determined in this study are shown in Table 1. None of the species had primary constriction in their chromosomes.

1. *Carex fusiformis* Nees ($2n = 44$, Fig. 1A)

Carex fusiformis is distributed in the Himalayas (India, Nepal, Bhutan) and China (Sichuan, Yunnan) (Noltie 1993, Govaerts and Simpson 2007). *Carex fusiformis* from Far West Nepal was found to have a chromosome number of $2n = 44$, confirming a previous report from the Langtang Himal in the central Nepal (Hoshino et al. 2000). Somatic metaphase chromosomes were less than $1.4 \mu\text{m}$ in length.

2. *Carex gracilentia* Boott ex Boeck. ($2n = 52$, Fig. 1B)

Carex gracilentia is distributed in the Himalayas (Noltie 1993, Govaerts and Simpson 2007). The specimen of *Carex gracilentia* had

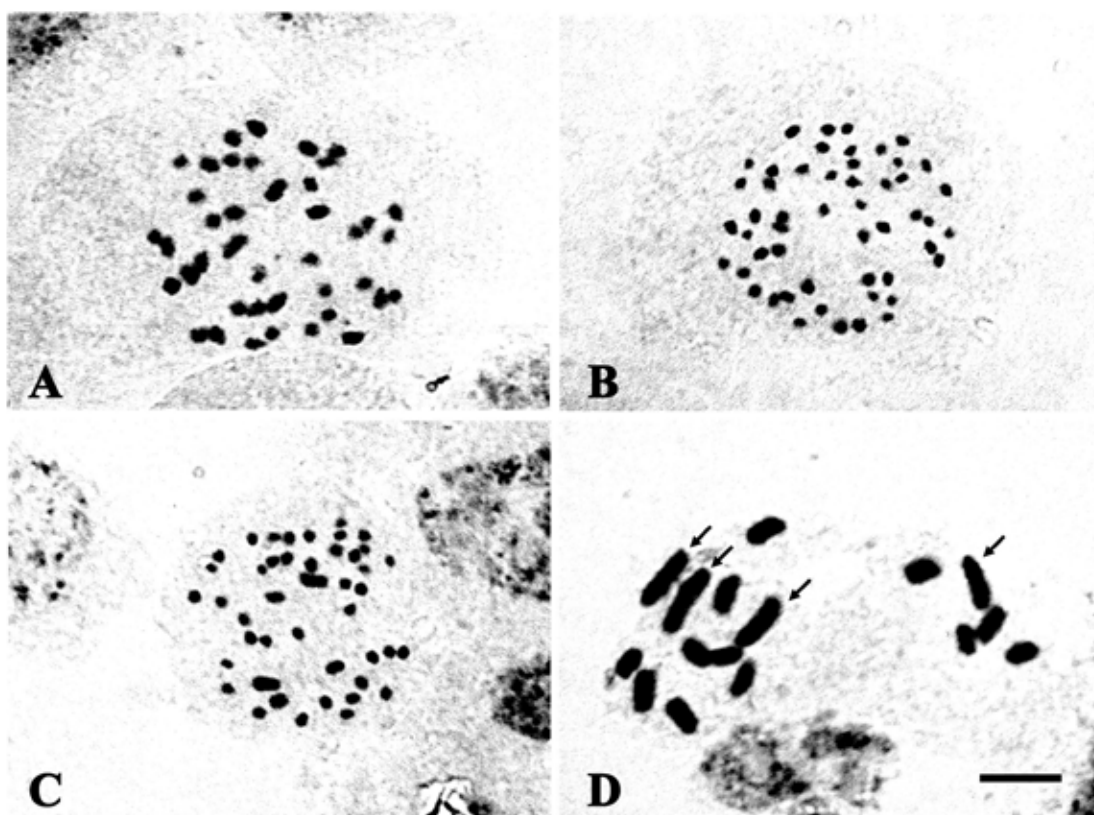


Fig. 1. Photomicrographs of somatic metaphase chromosomes of four species of Cyperaceae from Far West Nepal. A. *Carex fusiformis* ($2n = 44$). B. *C. gracilentia* ($2n = 52$). C. *C. longipes* ($2n = 46$). D. *Eleocharis palustris* ($2n = 16$). Arrows indicate four large chromosomes (L). Bar = 5 μm .

the chromosome number of $2n = 52$, and this is the first chromosome count to be determined for this species. Somatic metaphase chromosomes were less than 0.8 μm long. Kükenthal (1909) published a comprehensive monograph on *Carex*, in which he treated *C. gracilentia* as an infraspecific taxon of *C. alpina* Swartz, namely *C. alpina* subsp. *infuscatata* Nees var. *gracilentia* (Boott ex Boeck.) Kük. Kükenthal's broad circumscription of *C. alpina* included other intraspecific taxa, which Govaerts and Simpson (2007) recognized as independent species, such as *C. holostoma* Drejer, *C. lehmanii* Drejer, *C. media* R. Br., *C. norvegica* Retz., *C. parviflora* Host and *C. stevenii* (T. Holm) Kalela. Among these species chromosome numbers have been reported as $2n = 54, 56, 60$

for *C. holostoma* (Löve and Löve 1956, 1981, Jørgensen et al. 1958, Zhukova and Petrovsky 1975, Zhukova 1980, Yurtsev and Zhukova 1982, Dalgaard 1989), $2n = 56$ for *C. media* (Löve and Löve 1981 as *C. norvegica* subsp. *inferalpina* (Wahlenb.) Hultén), $2n = 54, 56, 66$ for *C. norvegica* (as *C. alpina*: Heilborn 1922, 1924, Tanaka 1942, as *C. norvegica*: Löve and Löve 1944, 1956, 1981, Jørgensen et al. 1958, Moore and Calder 1964, Zhukova and Petrovsky 1980), and $2n = 54$ for *C. parviflora* (Dietrich 1972). Our results offer support for the close relationship of *C. gracilentia* and the taxa Kükenthal included within *C. alpina* because of their similar chromosome numbers.

3. *Carex longipes* D. Don (2n = 46, Fig. 1C)

Carex longipes is distributed in the Himalayas (Kashmir to Bhutan), Nilgiri Mountains, Indo-China, and in central China (Koyama 1978). In the present study the chromosome number, 2n = 46, was observed, and somatic metaphase chromosomes were less than 1.2 µm in length. This is a new chromosome number for *C. longipes* as it has previously been reported as 2n = 42 by Sachdeva (1977) and Mehra and Sachdeva (1979) from Darjeeling in the eastern Himalaya, 2n = 44 by Nijalingappa and Leela (1990) from Tamilnadu and Karnataka in South India, and 2n = 44 by Hoshino et al. (2000: as *C. longipes* var. *nepalensis* Boott) from central Nepal. It seems that *C. longipes* may consist of a series of aneuploids, which is a fairly common phenomenon in *Cyperaceae* which have diffuse centromeric chromosomes.

4. *Eleocharis palustris* (L.) Roem. & Schult. (2n = 16, Fig. 1D)

Eleocharis palustris is widely distributed in the Himalayas, throughout temperate Asia, North America and Europe (Govaerts and Simpson 2007). In this study, *E. palustris* had the chromosome number of 2n = 16, and the somatic metaphase chromosomes showed a bimodal karyotype with 4 large (L) and 12 small (S) chromosomes. L-chromosomes ranged from 3.8 to 5.0 µm in length while S-chromosomes ranged from 2.1 to 2.7 µm. A bimodal karyotype, formulating 2n = 16 = 4L + 12S, of *E. palustris*, has frequently been reported for materials from Europe by Håkansson (1929), Strandhede (1965a, 1965b, 1965c), Thiébaud (1970), Pogan (1972), and Bureš et al. (2004). Hoshino et al. (2000) also reported such a bimodal karyotype for *E. palustris* from central Nepal. Our result agrees with previous studies, but more widespread investigations will be required to confirm that *E. palustris* possesses a bimodal karyotype throughout its whole distribution range.

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References

- Akiyama S, Wakabayashi M. and Ohba H. 1992. Chromosome evolution in Himalayan *Impatiens* (*Balsaminaceae*). Bot. J. Linn. Soc. **109**: 247–257.
- Bureš P., Rotreklová O., Stoneberg H. S. D. and Pikner R. 2004. Cytogeographical survey of *Eleocharis* subser. *Eleocharis* in Europe 1. *Eleocharis palustris*. Folia Geobot. **39**: 235–257.
- Dalgaard V. 1989. Additional chromosome numbers in vascular plants from the Disko Bugt area (west Greenland). Willdenowia **19**: 199–213.
- Dietrich W. 1972. In: IOPB chromosome number reports. XXXVI. Taxon **21**: 333–346.
- Govaerts R. and Simpson D. A. 2007. World checklist of *Cyperaceae*: Sedges, 765 pp. The Board of Trustees of the Royal Botanic Gardens, Kew.
- Håkansson A. 1929. Über verschiedene Chromosomenzahlen in *Scirpus palustris* L. Hereditas **13**: 53–60.
- Heilborn O. 1922. Die Chromosomenzahlen der Gattung *Carex*. Svensk Bot. Tidskr. **16**: 271–274.
- Heilborn O. 1924. Chromosome numbers and dimensions, species formation and phylogeny in the genus *Carex*. Hereditas **5**: 129–216.
- Hoshino T., Rajbhandari K. R. and Ohba H. 2000. Cytological studies of eleven species of *Cyperaceae* collected from Central Nepal. Cytologia **65**: 219–224.
- Ikeda H. and Ohba H. 1999. A systematic revision of genus *Potentilla* L. section *Leptostylae* (*Rosaceae*) in the Himalaya and adjacent regions. In: Ohba H. (ed.), The Himalayan Plants **3**: 31–117. University of Tokyo Press, Tokyo.
- Ikeda H., Noshiro S., Pendry C. A., Amano M., Bhatta, G. D., Bhattarai A. P., Dell B., Tanaka T., Wang Y. J. and Yamamoto N. 2010. Plant collecting in Doti and Bajhang districts in western Nepal in 2009. Newslett. Himal. Bot. (43): 1–10.
- Jørgensen C. A., Sørensen T. and Westergaard M. 1958. The flowering plants of Greenland. A taxonomical and

- cytological survey. Biol. Skr. Dansk. Vidensk. Selsk. **9**: 1–172.
- Koyama T. 1978. *Cyperaceae*. In: Hara H., Stearn W. T. and Williams L. H. J. (eds.), An Enumeration of the Flowering Plants of Nepal **1**: 96–120. British Museum (Natural History), London.
- Kükenthal G. 1909. *Cyperaceae–Caricoideae*. In: Engler A. (ed.), Das Pflanzenreich, IV. 20 (Heft 38). 824 pp. Wilhelm Engelmann, Leipzig.
- Löve A. and Löve D. 1944. Cytotaxonomical studies on boreal plants. III. Some new chromosome numbers of Scandinavian plants. Arkiv. Bot. **31**: 1–22.
- Löve A. and Löve D. 1956. Cytotaxonomical conspectus of the Icelandic flora. Acta Horti. Gothob. **20**: 65–291.
- Löve A. and Löve D. 1981. In: IOPB chromosome number reports. LXXIII. Taxon **30**: 845–851.
- Mehra P. N. and Sachdeva S. K. 1979. Cytological observations on some east Himalayan monocots. Cytologia **44**: 233–240.
- Moore R. J. and Calder J. A. 1964. Some chromosome numbers of *Carex* species of Canada and Alaska. Can. J. Bot. **42**: 1387–1391.
- Nijalingappa B. H. M. and Leela B. D. 1990. Cytological studies in some south Indian species of *Carex*. Cytologia **55**: 373–379.
- Noltie H. J. 1993. Notes relating to the Flora of Bhutan: XXI *Carex* (*Cyperaceae*). Edinb. J. Bot. **50**: 185–206.
- Pogan E. 1972. Studies in *Eleocharis* R. Br. I. Chromosome numbers of *E. palustris* (L.) R. & S. and *E. uniglumis* (Link) Schult. Acta Biol. Cracov. Ser. Bot. **15**: 69–75.
- Sachdeva S. K. 1977. In: IOPB chromosome number reports. LVI. Taxon **26**: 257–274.
- Strandhede S. O. 1965a. Chromosome studies in *Eleocharis*, subser. *Palustres*. II. Pollen mitosis with special reference to some strains with 15 chromosomes, and formation of secondarily unreduced pollen grains. Hereditas **53**: 374–388.
- Strandhede S. O. 1965b. Chromosome studies in *Eleocharis*, subser. *Palustres*. III. Observations on Western European taxa. Opera Bot. **9**: 1–86.
- Strandhede S. O. 1965c. Chromosome studies in *Eleocharis*, subser. *Palustres*. IV. A possible case of an extra, reductional division giving rise to hemi-haploid pollen nuclei. Bot. Not. **118**: 243–253.
- Tanaka N. 1942. Chromosome studies in *Cyperaceae*. XXI. Chromosome numbers of *Eucarex*. Med. Biol. **2**: 289–292.
- Thiébaud M. A. 1970. Contribution à l'étude caryologique du genre *Eleocharis* R. Br. en Suisse. Candollea **25**: 209–219.
- Wakabayashi M. and Ohba H. 1988. Cytotaxonomic study of the Himalayan *Saxifraga*. In: Ohba H. and Malla S. B. (eds.), The Himalayan Plants **1**: 71–90. University of Tokyo Press, Tokyo.
- Yano O., Ikeda H., Watson M. F., Rajbhandari K. R. and Ohba H. 2010. Cytological studies on *Cyperaceae* in the Nepal Himalaya I. Chromosome counts of fourteen species collected from the Manaslu Himalaya, Central Nepal. J. Jpn. Bot. **65**: 157–165.
- Yurtsev B. A. and Zhukova P. G. 1982. Chromosome numbers of some plants of the northeastern Yakutia (the drainage of the Indigirka River in its middle reaches). Bot. Zhurn. **67**: 778–787.
- Zhukova P. G. 1980. Chromosome numbers of some Southern Chukotka plant species. Bot. Zhurn. **65**: 51–59.
- Zhukova P. G. and Petrovsky V. V. 1975. Chromosome numbers of some Western Chukotka plant species. Bot. Zhurn. **60**: 395–401.
- Zhukova P. G. and Petrovsky V. V. 1980. Chromosome numbers and taxonomy of some species of the Anyui Mts. Bot. Zhurn. **65**: 651–659.
- 極西ネパールより採集したカヤツリグサ科植物4種について染色体数を報告した。 *Carex gracilentia* Boott ex Boeck. の染色体数 $2n = 52$ は、今回が初めての報告である。 *C. longipes* D. Don ($2n = 46$) は、これまでの報告と異なった染色体数が算定され、種内に異数性の系列があると考えられた。 *C. fusiformis* Nees ($2n = 44$) と *Eleocharis palustris* (L.) Roem. & Schult. ($2n = 16 = 4L + 12S$) については、これまでの報告と一致した。
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